

QR, Interface Economy and Pied-Piping in English*

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The possibility of pied-piping in English differs depending on the types of clauses where pied-piping takes place and this has made it difficult to come up with a unitary analysis of pied-piping. The goal of this paper is to provide a unified analysis of pied-piping in English without excluding any of them from the general pied-piping mechanism. Based on cross-linguistic data, I claim that pied-piping is the result of feature percolation and that feature percolation is possible only from certain structural positions. An interesting prediction of this analysis combined with an assumption that covert movement can precede overt movement (Chomsky, 1998, etc.) is that an XP can be pied-piped by a wh-element which is not in its initial position on the surface. I claim that this is what underlies pied-piping by non-phrase-initial wh-elements in English. In addition, I propose that the covert movement of the wh-phrase involved in certain cases of pied-piping by non-phrase-initial wh-phrases in English is QR and that various properties manifested by this kind of pied-piping can be explained in terms of the unique properties of QR distinct from those of other A'-movements. Specifically, I show how adopting the view of QR as an operation motivated by Interface Economy, as proposed by Reinhart (1995) and Fox (1995, 2000), can shed light on why pied-piping by non-phrase-initial wh-elements yields less-than-perfect results except in appositive relative clauses and why clausal pied-piping is restricted in English unlike in other languages like Basque.

Key words: pied-piping, QR, interface economy, scope economy, feature percolation, Subjacency

1. Introduction

It has been observed that the possibility of pied-piping in English

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differs depending on the types of clauses where pied-piping takes place. Granting some variation in native speakers' grammaticality judgments, pied-piping in relative clauses is reported to be less constrained than that in questions. Among relative clauses, pied-piping is freer in appositive relative clauses than in restrictive relative clauses and among questions, pied-piping in matrix questions is easier than in embedded questions.

- (1) a. *Ann asked me [pictures of whom] I like most.
- b. *?[Pictures of whom] do you like most?
- c. ?Ann met the politician [pictures of whom] she saw in the magazine.
- d. Ann met the politician, [pictures of whom] she happened to see in the magazine.

This state of affairs has made it difficult to come up with a unitary analysis of pied-piping. In the literature on pied-piping, basically two approaches are found. First, many analyses either do not discuss the differences at all or recognize them but do not provide any explanations for them. Ross's (1967) classic analysis of pied-piping, Nanny and Stillings (1978), Ishihara (1984), and Cowper (1987) belong to this category. A different approach to the problem was taken by researchers like Emonds (1979, 1985) and Webelhuth (1989). These researchers recognize the differences and attempt to come up with a unitary account of pied-piping by excluding pied-piping in certain types of clauses from the general pied-piping phenomenon. For example, both Emonds and Webelhuth claim that pied-piping in appositive relative clauses fall outside the general principle of pied-piping and should be handled in terms of a syntactic mechanism independent from pied-piping, i.e., Topicalization. In a similar fashion, the fact that pied-piping is easier in matrix questions than in embedded questions has often been attributed to the possibility of matrix questions being interpreted as an echo question. Neither approach is satisfactory. As for the first approach, it is not satisfactory in that the different properties are simply ignored or left unexplained. As for the second approach, I will show that there is evidence that pied-piping in different types of clauses should be handled by the same general pied-piping mechanism.

In addition to language-internal evidence from English, the claim that pied-piping in all types of clauses should be treated in a unified manner

is based on cross-linguistic considerations about pied-piping. Specifically, pied-piping observed in overt Wh-movement languages like Basque, Imbabura Quechua and Tzotzil clearly shows that in order for a wh-phrase to pied-pipe a constituent, it must move to some phrase-initial position, which can reasonably be taken as Spec (Ortiz de Urbina, 1993; Cole, 1982; Aissen 1996). Drawing on this cross-linguistic data, I will first propose an analysis of pied-piping based on the movement of wh-phrase to the Spec of pied-piping phrases followed by feature percolation, and then I will show how it can be extended to pied-piping in English. If we assume that an XP must have a wh-feature in order to undergo Wh-movement and that feature percolation is possible only from Spec, it is predicted that in order for a wh-phrase to be a pier-piper, it must be in Spec, either by base-generation or movement. In addition, if we assume the Cyclic Spell-out model (Chomsky, 1998), where covert movement can precede overt movement, it is predicted that a phrase can be pied-piped by a wh-phrase which is not in the Spec overtly as long as it can move into it covertly. I propose that this is what underlies the pied-piping by non-phrase-initial wh-elements in English.

If this is the case, however, problems arise concerning why pied-piping by non-phrase-initial wh-phrases, except for PP pied-piping, is either ungrammatical or highly marked except in appositive relative clauses, as we have seen in (1). As an answer, I will propose that it can be attributed to the unique nature of covert movement involved in this type of pied-piping, i.e., it is Quantifier Raising. Adopting, furthermore, the view of QR as an operation motivated by Interface Economy proposed by Reinhart (1995), I will show how the clause-type sensitivity of pied-piping in English can be explained. To be more specific, my claim is that pied-piping by non-phrase-initial wh-elements is, in principle, possible in all clause types, but is made highly marked/ungrammatical due to the nature of QR as an operation motivated by Interface Economy. It provides a piece of evidence for this analysis that those cases of pied-piping which are sensitive to the types of clauses where pied-piping takes place and have been claimed to fall outside the general pied-piping convention are mainly the instances of pied-piping by non-phrase-initial wh-phrases, which involves QR in my analysis. I will also show how the pattern of clausal pied-piping in English, first observed by Nanny and Stillings (1978), can be explained in terms of the unique locality of QR. The locality of QR, in turn, will be attributed to the condition of Scope

Economy, a slightly different version of Interface Economy proposed by Fox (1995, 2000).

The organization of the paper is as follows. In section 2, I will examine how pied-piping differs depending on the types of clauses where it takes place and how they have been handled in the previous literature on pied-piping. I will then argue against the Topicalization approach proposed by Emonds (1979) and Webelhuth (1989). In section 3, I will propose an analysis of pied-piping based on movement and feature percolation drawing on pied-piping data in other languages like Basque and Imbabura Quechua. I will then show how this analysis can be extended to pied-piping in English. In section 4, I will discuss the notion of Interface Economy proposed by Reinhart (1995) and show how it can shed light on explaining some of the unique properties of pied-piping in English. Specifically, I will discuss various properties shared by constructions involving QR and pied-piping and how they can be naturally explained by assuming that QR is involved in certain instances of pied-piping in English. Based on this, in section 5, I will show how various properties of pied-piping in English such as the clause-type sensitivity of pied-piping and the pattern of clausal pied-piping can be explained. I will also discuss how the unique locality of QR, which plays an important role in my analysis of pied-piping, can be derived from the notion of Scope Economy proposed by Fox (1995, 2000). In section 6, I will discuss how the two different notions of Interface Economy I have appealed to in order to explain some properties of pied-piping in English, i.e., Interface Economy of Reinhart and Scope Economy of Fox, can be incorporated to yield the desired explanations. Finally, in section 7, the claims made in this paper will be summarized.

2. Pied-Piping in Different Types of Clauses

2.1. Basic Facts

Pied-piping in English shows different properties depending on the types of clauses where it takes place. For example, Emonds (1979) discusses the following pairs of sentences which show the contrast between pied-piping in questions and relative clauses. Sentences in (2) show that a DP can be pied-piped in relative clauses in (2b) but the same

DP cannot be pied-piped in questions in (2a).

- (2) a. *Ann never told me two sides of which box she had put the address on.
- b. Ann never told me about that box, two sides of which she had put the address on. (Emonds, 1979, p. 224)

Similar data were also discussed in Webelhuth (1989). The contrast in (3) below shows that an AP *proud of whom* can be pied-piped in relative clauses but not in questions.

- (3) a. *I asked Bill proud of whom he has always been.
 - b. This is the kind of woman proud of whom I could never be.
- (Webelhuth, 1989, p. 129)

Further differences were also observed between appositive and restrictive relative clauses and between matrix questions and embedded questions, although there have been some disagreements about the data. As for relative clauses, Emonds (1979) claims that restrictive and appositive relative clauses behave differently with respect to pied-piping based on examples like the following.

- (4) a. *Few windows here the curtains on which I really dislike let in enough light.
- b. Few windows here, the curtains on which I really dislike, let in enough light. (Emonds, 1979, p. 224)

He claims that pied-piping of the DP *the curtains on which* is not possible when the relative clause is interpreted with a restrictive meaning as in (4a), while it is possible when the relative clause is interpreted with an appositive meaning. As evidence for this, Emonds (1985) further shows that when the possibility of a relative clause being interpreted as an appositive relative clause is very low due to the choice of the head of the relative clause, pied-piping is impossible. The pattern of relative degradedness in grammaticality from (5a) to (5c) below shows this.

- (5) a. *Most students are interested in **any professor** [a security file on whom] the government won't release.
 b. ?We should visit **only the city** [a favorable report on which] Jack received.
 c. Most students are interested in **Prof. Rotestern**, [the security file on whom] the government won't release. (Emonds, 1985, p. 304)

However, no distinctions were made between restrictive relative clauses and appositive relative clauses by researchers like Ross (1967) or Webelhuth (1989).

As for questions, it was observed that pied-piping in matrix questions is generally judged to be better than pied-piping in embedded questions.

- (6) a. ??[Pictures of which actor] do you like most?
 b. *I wonder [pictures of which actor] he likes most.

This relative well-formedness of pied-piping in matrix questions has often been attributed to the fact that matrix questions, unlike embedded questions, can be interpreted as an echo question (Cowper, 1987, p. Kayne 1994).

In short, the general pattern in the possibility of pied-piping can be summarized as follows:

(7) Relative Easiness of Pied-piping

appositive relative clauses > restrictive relative clauses > matrix questions > embedded questions

An interesting and important thing about these different pied-piping possibilities in different types of clauses is that the kind of pied-piping that shows this kind of clause-type sensitivity involves pied-piping by non-phrase-initial wh-elements, if we set aside PP pied-piping as in (8).

- (8) a. I wonder [to whom] she talked.
 b. Mr. Smith, [to whom] she talked all day, is a college professor.

In contrast to pied-piping by non-phrase-initial wh-phrases, pied-piping by a phrase-initial wh-element does not manifest this kind of clause-type sensitivity. So as we see in (9), pied-piping of DP by phrase-initial wh-

elements is possible both in questions and relative clauses. Sentences in (10) show that the same is also true of pied-piping of AP or AdvP by phrase-initial *wh*-elements.

- (9) a. [Whose pictures] did you see?
 b. the man, [whose pictures] I saw on the newspaper,
- (10) a. [How smart] is he?
 b. [How fast] can he run?

Note, also, that certain cases of pied-piping are uniformly ill-formed regardless of the types of clauses where pied-piping takes place. For example, pied-piping a finite clause in (11a) or a non-finite clause with a lexical subject in (11b) is always impossible (Nanny & Stillings, 1978; Ishihara, 1984).

- (11) a. *They bought a car, [that their son might drive which] was a surprise to them.
 b. *The elegant parties, [for us to be admitted to one of which] was a privilege, had usually been held at Delmonico's. (Nanny & Stillings, 1978, p. 312)

As we will see shortly, these facts will shed some light on explaining the observed pattern of pied-piping in English.

2.2. Previous Analyses

Basically two approaches to this problem are found in the previous literature on pied-piping. First of all, many of the analyses are silent about the differences. For instance, in his classic analysis of pied-piping, Ross (1967) discusses pied-piping of complex NPs like the following in relative clauses and proposes his pied-piping convention based on it.

- (12) Reports [the lettering on the covers of which] the government prescribes the height of are a shocking waste of funds. (Ross, 1967, p. 109)

(13) The Pied-Piping Convention

Any transformation which is stated in such a way as to effect the

reordering of some specified node NP, where this node is preceded and followed by variables in the structural index of the rule, may apply to this NP or to any non-coordinate NP which dominates it, as long as there are no occurrences of any coordinate node, nor of the node S, on the branch connecting the higher node and the specified node. (Ross, 1967, p. 114)

Ross, however, does not discuss why the same kind of pied-piping, as in (14), is not possible in questions.

- (14) *I wonder [the lettering on the covers of which] the government prescribes the height of.

Similar problems are also found in some of the later analyses such as Nanny and Stillings (1978) and Ishihara (1984). Like Ross, these analyses take pied-piping in relative clauses as the basis of their analysis of pied-piping and propose an analysis that can explain it.¹⁾ Also like Ross, they do not discuss why the same kind of pied-piping is not possible in questions. For example, Nanny and Stillings claim that pied-piping observes PIC (Proposition Island Condition)/SSC (Specified Subject Condition) based on the data like the following which show that pied-piping finite clauses and non-finite clauses with a lexical subject is impossible, while pied-piping a non-finite clause without a lexical subject is possible.²⁾

- (15) a. *They bought a car, [that their son might drive which] was a surprise to them.
 b. *The elegant parties, [for us to be admitted to one of which] was a privilege, had usually been held at Delmonico's.
 c. The elegant parties, [to be admitted to one of which] was a privilege, had usually been held at Delmonico's (Nanny & Stillings, 1978, p. 312)

It was not discussed, however, why pied-piping a non-finite clause without a lexical subject, which is possible in appositive relative clauses,

1) To be more precise, their data all involve appositive relative clauses.

2) A closer look into the data will reveal that facts are more complicated than this. See section 5.3.2. for the discussion.

is not allowed in questions.

- (16) *I wonder [to be admitted to one of which parties] he will do anything.

In a different take at the problem, Cowper (1987) does recognize the differences between pied-piping in relative clauses and questions, specifically pointing out the problem the ungrammaticality of sentences like (14) poses to Ross' pied-piping convention. She then goes on to explain the impossibility of pied-piping as in (14) by adopting a feature percolation mechanism which ensures that features can percolate only from the head and the Spec, but not from the complement or adjunct position. This approach, however, is not satisfactory, either, since now the grammaticality of pied-piping in relative clauses is not explained.

A rather different approach to the problem was taken by researchers like Emonds (1979, 1985) and Webelhuth (1989). They recognize the differences between pied-piping in questions and relative clauses and attempt to explain them by excluding pied-piping in relative clauses from the general pied-piping phenomenon. Specifically, both Emonds and Webelhuth claim that pied-piping in relative clauses fall outside the general principle of pied-piping and should be handled in terms of a syntactic mechanism independent from pied-piping, i.e., Topicalization. For example, Emonds attributes the less constrainedness of pied-piping in appositive relative clauses to the fact that appositive relative clauses have root clause status, unlike other dependent clauses. Given that Topicalization is possible only in root clauses, it is explained why pied-piping in appositive relative clauses behaves differently from that in questions or restrictive relative clauses.

A more recent proposal made by Webelhuth (1989) takes basically the same approach. Working on pied-piping in Germanic languages, Webelhuth proposes an analysis of pied-piping based on feature percolation and Theta theory. He claims that features can percolate from certain structural positions to the mother node and that this feature percolation enables the constituent with the percolated feature to undergo pied-piping movement. Since his theory of feature percolation combined with Theta theory does not allow features to percolate from positions other than Spec and Head, except for the special cases of PPs, his analysis predicts that only the *wh*-phrase in the Spec of XP, the phrase-initial

position, can be pied-pipers. The instances of pied-piping by non-phrase-initial *wh*-elements in English relative clauses, thus, are not explained. Faced with this problem, Webelhuth claims, like Emonds, that these instances of pied-piping by non-phrase-initial *wh*-elements are not genuine cases of pied-piping but involve Topicalization. As evidence for this, he observes that this kind of pied-piping in relative clauses sounds “old-fashioned” and “bookish” and that it is not found in other Germanic languages.

Contra Emonds and Webelhuth, however, there is evidence showing that Topicalization cannot explain pied-piping in relative clauses and pied-piping in relative clauses should also be handled by the same mechanism that explains pied-piping in questions. This will be discussed in the next section.

2.3. Against the Topicalization Approach to Pied-Piping in Relative Clauses

First of all, a crucial piece of evidence against the Topicalization approach to pied-piping in relative clauses is that there is no correlation between the possibility of pied-piping and Topicalization. If those marked instances of pied-piping that are allowed in relative clauses but not in questions involve Topicalization, the prediction is that there must be a correlation between whether an XP can undergo a pied-piping movement and whether it can be topicalized. This prediction, however, is not borne out. First, it is not the case that all topicalizable XPs can be pied-piped. Subjects DPs are such cases. Although subjects cannot be topicalized in (17a), they can undergo pied-piping movement in (17b).

- (17) a. *[The investigation of the murder case]_i t_i was cancelled.
- b. The crime, [the investigation of which]_i t_i was called off by the police, was committed by a notorious serial killer.

Given that subjects in general cannot be topicalized, the grammaticality of (17b) is not explained, if this kind of pied-piping in relative clauses is made possible by the independent topicalizability of the XP containing the *wh*-phrase. Secondly, there are many phrases which can be topicalized but do not allow pied-piping. For example, finite clauses can be topicalized but they cannot be pied-piped, even in appositive relative clauses.

- (18) a. [That Mary loves John], everyone believes *t* strongly.
 b. *The man, [that Mary loves whom] everybody knows *t*, is my brother.

The same is true of complex NPs.

- (19) a. [Every book Tolstoy wrote], I read *t* so many times.
 b. *The book, [the writer who wrote which] I like *t* very much, became a bestseller.

If the marked instances of pied-piping in relative clauses are made possible as the result of Topicalization, note that there is no reason why sentences like (18b) and (19b) are not grammatical. The ungrammaticality of sentences (18b)-(19b) thus shows that the inadequacy of the Topicalization approach.

Secondly, the Topicalization approach cannot explain the contrast between a pair of sentences like those in (20), which shows that the same constituent can be pied-piped or not depending on the position of the *wh*-element in it. In (20), the same DP can or cannot be pied-piped depending on whether the *wh*-phrase is in the subject in (20a) or object in (20b) position inside the DP.

- (20) a. *John Smith, [the possibility of who(m) marrying you] became a reality on yesterday...
 b. The man, [the possibility of marrying whom] excited Mary, is my brother. (Kayne, 1983; Cinque, 1990, p. 137)

This state of affairs is not expected if pied-piping by non-phrase-initial *wh*-elements in relative clauses involves Topicalization. According to the Topicalization approach, there is no reason why the different positions the *wh*-phrase occupies within the topicalized DP should affect the well-formedness of Topicalization.

Another problem of Topicalization approach is that according to some researchers like Radford (1997), certain instances of pied-piping by non-phrase-initial *wh*-elements are possible even in questions.³⁾

3) Concerning the contrast in grammaticality judgment between (21a) and (21b), the native speakers I have consulted report that the distinction between the two is subtle, although

- (21) a. [Pictures of whose mother] did you think *t* were on the mantelpiece?
 b. *?[Pictures of whose mother] did you see *t* on the mantelpiece?
 (Radford, 1997, p. 280)

According to Radford, pied-piping of a subject DP by a non-DP-initial *wh*-element is possible unlike that of an object DP. He attributes this contrast to the nature of pied-piping as a last resort measure: DP pied-piping in (21a) is made possible since extracting the *wh*-word alone out of the subject island is not possible, whereas it is not possible in (21b) since the extraction is from the object DP, which is not a syntactic island. Setting aside the validity of this explanation for the moment,⁴⁾ if DP pied-piping by a non-DP-initial *wh*-element is possible even in *Wh*-questions, the less constrainedness of pied-piping in relative clauses cannot be attributed to the fact that pied-piping in relative clauses can involve Topicalization unlike that in questions. As we can see, Subject-Aux Inversion in (21a) clearly shows that the fronted phrase in (21) underwent pied-piping *Wh*-movement, not Topicalization.

Finally, one more problem specifically with Webelhuth (1989) is the inconsistency in his explanation. As noted, he assumes that pied-piping in relative clauses in general is freer than that in questions. The problem is that unlike in appositive relative clauses, (thematic) topics are not allowed in restrictive relative clauses.⁵⁾ If the less constrainedness of pied-piping in relative clauses is due to the availability of Topicalization but topics are not allowed in restrictive relative clauses, the prediction is that pied-piping in restrictive relative clauses should pattern with that in

(21a) is better than (21b). They find (21a) still somewhat marginal and (21b) not completely ungrammatical. In addition, the corresponding pied-piping in embedded questions is more degraded than in matrix questions.

(i) a. ?I wonder [pictures of whose mother] he thinks *t* were on the mantelpiece.
 b. *?I wonder [pictures of whose mother] he saw *t* on the mantelpiece.

See the related discussion in section 5 and 6 for an explanation for this kind of grammaticality judgment.

4) Contra Radford and the widely-accepted assumption, I will show that pied-piping is not a last resort measure based on various evidence. See section 3.1. for the discussion on this. See also section 6 for why the last resort cases of pied-piping as in (21a) could yield improved grammaticality judgments compared to the cases of pied-piping which do not have the last resort flavor such as (21b).

5) See section 5 for more discussion on this.

questions, not in appositive relative clauses.

To summarize, the preceding discussion shows the inadequacies of the Topicalization approach in explaining the differences between pied-piping in different types of clauses. In the following sections, I will present an analysis which can explain, in a unified manner, the different properties that pied-piping in different types of clauses manifest. For this goal, first, I will examine some cross-linguistic data on pied-piping and discuss what they suggest to the proper analysis of pied-piping in English.

3. Cross-Linguistic Variation and Two-Step Movement Approach to Pied-Piping in English

3.1. Overt Clausal Pied-Piping in Basque and Imbabura Quechua

Pied-piping shows a great deal of variation among languages. Thus, although pied-piping in languages like English is quite constrained, there are languages where pied-piping is much freer. Basque and Imbabura Quechua are two well-known examples. In these languages, large phrases such as tensed clauses can be pied-piped, as we see below.

*Basque*⁶⁾

- (22) [Nor etorri d-ela] esan du Mirenek uste du-ela Jonek?
 who come aux-that said has Mary think aux-that John
 'That who has come has Mary said (that) John thinks?'
 (Ortiz de Urbina, 1993, p. 194)

Imbabura Quechua

- (23) [Ima-ta Juan randi-shka]-ta-taj pro ya-ngui?
 what-ACC Juan buy-NML-ACC-Q (you) think-2
 'What do you think that Juan bought?' (Cole, 1982, p. 21)

Both Basque and Imbabura Quechua are overt Wh-movement languages and sentences (22) and (23) show that clauses can be pied-piped in these languages. More importantly, pied-piping in these languages show that in

6) Basque is a V2 language and thus movement of the complement clause of the verb to the Spec of CP triggers Subject-Aux Inversion, producing V2 word order.

order for an XP to be pied-piped by a wh-phrase, a certain structural condition should be met, i.e., the wh-phrase must move to the XP-initial position. (22) and (23) show that the wh-phrases have moved to clause-initial position. The ungrammaticality of (24) in Imbabura Quechua, in contrast to (23), more clearly shows this.

- (24) *[Juan ima-ta randi-shka]-ta-taj_i pro ya-ngui t_i.
 Juan what-ACC buy-NML-ACC-Q (you) think-2
 'What do you think that Juan bought?'

The wh-phrase in (24) is in its base position, and it is ungrammatical.

That a wh-element must move to the phrase-initial position in order to be a pied-piper is also observed in Tzotzil (Aissen, 1996). As we see below, in order for a DP or PP to be pied-piped in Tzotzil, the wh-phrase must move to the initial position of these phrases.⁷⁾

- (25) a. [Buch'u x-ch'amal]_i i-cham t_i?
 who A3-child CP-died
 'Whose child died?'
 b. *[X-ch'amal buch'u]_i i-cham t_i?
 A3-child who CP-died
 'Whose child died?' (Aissen, 1996, p. 457)
- (26) a. [Buch'u ta s-na] ch-a-bat?
 who P A3-house ICP-B2-go
 'To whose house are you going?'
 b. *[Ta s-na buch'u] ch-a-bat?
 P A3-house who ICP-B2-go
 'To whose house are you going?' (Aissen, 1996, p. 470)

Since the non-wh-complement of a noun or a preposition can appear after the head in Tzotzil, Aissen analyzes the preceding fact as showing that the wh-complement of N/P must move to the Spec of DP/PP in order for the whole DP/PP to be pied-piped.⁸⁾

7) The following abbreviations are used in the gloss: A3: Set A affixes, 3rd person, ICP: incomplete aspect, CP: completive aspect, ENC: enclitic

8) To be precise, what is moved in (26a) is not the whole complement of P, *buch'u s-na* or

In short, what pied-piping in languages like Basque, Imbabura Quechua and Tzotzil clearly show is that in order for an XP to be pied-piped, a *wh*-phrase must move to the phrase-initial position, which can reasonably be viewed as Spec. This, in turn, can be explained if we assume that *wh*-features can percolate only from the Spec (and the head) to the mother node⁹⁾ and that pied-piping is permitted as the result of this feature percolation (Ortiz de Urbina, 1993; Horvath, 1997, etc.). In addition, we have to assume that feature percolation is optional, given the data like the following in Basque and Imbabura Quechua, which are the non-pied-piped versions of sentence (22) and (23).

- (27) Nor esandu Mirenek uste du-ela Jonek etorri d-ela?
 who said aux Mary think aux-that John come aux-that
 'Who has Mary said John thinks will come?' (Otriz de Urbina, 1993, p. 194)
- (28) Ima-ta-taj ya-ngui Juan randi-shka-ta?
 what-ACC-Q think-2 Juan buy-NML-ACC
 'What do you think that Juan bought?' (Cole, 1982, p. 21)

As we see, in these sentences, the *wh*-phrase alone has moved to the Spec of matrix C and there was no pied-piping. Given that movement of the *wh*-phrase to the Spec of embedded C is necessary for Subjacency reasons, the conclusion we can draw is that feature percolation is optional. When feature percolation takes place, the whole phrase with the percolated feature, i.e., the whole CP, undergoes movement as we saw in (22)-(23), while when there is no feature percolation, only the *wh*-phrase moves out to the Spec of matrix C ((27)-(28)).

One prediction of this analysis is that any XP whose Spec can be occupied by a *wh*-element, by base-generation or movement, can undergo pied-piping movement. Furthermore, if we assume that covert movement can precede overt movement under the Cyclic Spell-Out model (Chomsky, 1998; Uriagereka, 2000),¹⁰⁾ an interesting prediction that follows is that an

s-na buch'u but only the *wh*-possessor, *buch'u*. Descriptively, it seems that recursive pied-piping is not allowed in Tzotzil (Aissen, 1996). Recursive pied-piping is also banned in San Dionicio Zapotec, which shows the similar pattern of pied-piping as Tzotzil (Broadwell, 2001).

9) This will be revised in section 4.3.

XP can be overtly pied-piped not only by a wh-phrase which was base-generated in it or has moved to its Spec overtly, but also by one which has moved to it covertly.^{11) 12)} This means that a phrase can be pied-piped by a non-phrase-initial wh-element, as long as it can move into the Spec covertly without violating any syntactic constraints. In the next section, I will show how this analysis can provide explanations for various facts of pied-piping in English.

Before we move on to pied-piping in English, let me first note that the preceding data and analysis clearly show that the widely-made assumption about pied-piping, i.e., that pied-piping is a last resort measure, cannot be maintained. If pied-piping is a last resort measure, it predicts that pied-piping will be possible only when moving a smaller constituent alone is impossible and that it will be always possible in such cases. This means that pied-piping cannot be optional and that any constituent should be able to be pied-piped, if moving a smaller constituent is not possible for some reason. Neither prediction is borne out.

First, as we have already seen, pied-piping in languages like Basque and Imbabura Quechua can be optional ((22-23) vs. (27-28)). Optionality of pied-piping is also observed in English. For example, PP pied-piping in

10) Single Output Syntax (Bobaljik, 1995; Brody, 1995; Pesetsky, 1999, etc.) also allows covert movement to precede overt movement. In the Single Output syntax, the only difference between overt and covert movement is which copy in the movement chain is pronounced.

11) Contra Chomsky (1998), however, I will not adopt the idea that covert movement is Agree, due to the difficulties in incorporating it to the proposed mechanism of pied-piping. First of all, it is not clear exactly what feature of the head of the pied-piping XP agrees with the wh-phrase. Secondly and more importantly, even if we posit some feature, like a D-feature, it is difficult to incorporate the notion of Agree to the feature percolation mechanism crucial to pied-piping. Specifically, given that the feature of the head X that enters into Agree relation with the wh-phrase is not the wh-feature but some other feature such as D-feature, it is difficult, although not impossible, to see how the wh-feature of the wh-phrase in the base position can percolate to the dominating XP node. In the following sections, I am going to claim that covert Wh-movement involved in pied-piping is QR and that QR is motivated by Interface Economy, not by feature checking. See Pesetsky (2000) for the claim that covert phrasal movement does exist.

12) The prediction of this analysis is that there can be four different types of pied-piping patterns, depending on the overt/covert nature of two steps of movement involved in pied-piping: first, an XP can be overtly pied-piped by a wh-phrase which is overtly moved to (or base-generated in) its Spec; second, an XP can be overtly pied-piped by a wh-phrase which is covertly moved to its Spec; third, an XP can be covertly pied-piped by a wh-phrase which is covertly moved to its Spec; and finally, an XP can be covertly pied-piped by a wh-phrase which is covertly moved to its Spec. Based on this, Yoon (1999, 2001) proposes a typology of four different types of languages with respect to pied-piping (or four different patterns of pied-piping). See Yoon for more discussion on this.

(29) and pied-piping by non-phrase-initial *wh*-elements in appositive relative clauses in (30) show that pied-piping can be optional in English.

- (29) a. To whom did you talk?
b. Whom did you talk to?
- (30) a. The man, pictures of whom you saw on the magazine, is my brother.
b. The man, whom you saw pictures of on the magazine, is my brother.

If pied-piping is a last resort measure, this kind of optionality is not expected.

Secondly, it is not the case that any constituent can be pied-piped when moving a smaller element is impossible. There are many examples that show that pied-piping is not possible although moving the *wh*-phrase alone clearly is not possible. For example, pied-piping a complex NP or adjunct island is impossible in English in (31), although moving the *wh*-phrase alone out of the island is not possible in (32).

- (31) a. *[The writer who wrote which novel] do you like?
b. *The book, [the writer who wrote which] happens to be here now, is very interesting.
c. *[Because John likes whom] is Mary upset?
d. *The man, [because John likes whom] Mary is upset, came to see her.
- (32) a. *Which novel do you like the writer who wrote?
b. *The book, which the writer who wrote happens to be here now, is very interesting.
c. * Whom is Mary upset because John likes?
d. *The man, whom Mary is upset because John likes, came to see her.

As we see in (31b) and (31d), pied-piping of a complex NP or adjunct island is not allowed even in appositive relative clauses.

In short, what the preceding discussion shows is that the claim that pied-piping is a last resort measure cannot be maintained. What I have

proposed instead is that pied-piping takes place when certain structural configurations are met, i.e., when the *wh*-phrase is in the Spec of the pied-piped phrase, either overtly or covertly.¹³⁾

3.2. Applying the Two-Step Movement Approach to Pied-Piping in English

The proposed analysis of pied-piping based on movement and feature percolation can readily explain the well-behaved cases of pied-piping in English such as the following, where an XP is pied-piped by a *wh*-phrase in the initial position.

- (33) a. Whose book did you read?
 b. How old are you?
 c. How fast can he learn?

Assuming that the *wh*-phrase in these cases is in the Spec, the grammaticality of pied-piping in (33) is readily explained.

In addition, the analysis can provide an immediate explanation for some of the problematic cases of pied-piping in English such as PP pied-piping in general and other instances of pied-piping by non-phrase-initial *wh*-elements in relative clauses. Recall that these are the problematic cases that were difficult for researchers like Webelhuth (1989), since unlike other well-formed instances of pied-piping, these cases involve pied-piping by non-phrase-initial *wh*-elements. In general, pied-piping by non-phrase-initial *wh*-elements has been taken as a problem for an approach which assumes that feature percolation is possible from Spec but not from complement or adjunct positions. Since the *wh*-phrase is not in the Spec position in this kind of pied-piping, the *wh*-feature cannot percolate to the dominating XP and thus pied-piping should not be possible.

Note, however, that pied-piping by non-phrase-initial *wh*-elements is not a problem, if we assume that movement is involved in pied-piping and furthermore, that covert movement can precede overt movement. For PP pied-piping, we can simply say that the *wh*-complement of P has covertly

13) The exact position to which the *wh*-phrase moves in the pied-piped phrase will be revised in section 4.3.

moved to the Spec of PP and percolated its *wh*-feature to PP, thereby overtly pied-piping the PP.

- (34) a. To whom did you talk?
 b. Did you talk [*whom*_i to *t*_j]^{wh}? (covert movement+feature percolation)
 --> [*whom*_i to *t*_j]^{wh} did you talk *t*_j? (overt movement)

The cases where prepositions are stranded are not a problem, either, since feature percolation is optional, as we have seen in the case of clausal pied-piping in Basque and Imbabura Quechua.

We can provide the same explanation for pied-piping by non-phrase-initial *wh*-elements in relative clauses such as the following.

- (35) a. Ann never told me about that box, [two sides of which] she
 had put the address on.
 b. This is the kind of woman [proud of whom] I could never be.

In these cases also, we can assume that the *wh*-phrase has covertly moved to the Spec of the pied-piped DP/AP and subsequently percolated its *wh*-feature to the DP/AP.

If this is the case, however, different kinds of problems arise. First, theoretically, it has to be explained what motivates the *wh*-phrase to move to the Spec of the pied-piping phrase. Secondly and more importantly, it has to be explained why most cases of pied-piping by non-phrase-initial *wh*-elements produce less-than-perfect results except in appositive relative clauses. In addition, it has to be explained why certain instances of pied-piping by non-phrase-initial *wh*-phrases are ungrammatical even in appositive relative clauses. We have already seen that tensed clauses and non-finite clauses with an overt subject in English cannot be pied-piped ((15)). Pied-piping a complex NP or adjunct island is also not possible ((31)). This contrasts with the grammaticality of such pied-piping in Basque or Imbabura Quechua. Therefore, in order for the proposed analysis of pied-piping in English to be complete, these facts have to be explained in a principled way.

I propose that these problems can be explained if we assume that the covert movement of the *wh*-phrase to the Spec of pied-piping XP is Quantifier Raising and furthermore, that QR is an operation motivated not by feature checking but by Interface Economy, as proposed by

Reinhart (1995). In short, my claim is that certain instances of covert movement of the *wh*-phrase to the Spec of pied-piped XP are QR and as such, show the unique properties associated with QR.¹⁴⁾ Before I go on to show how various properties of pied-piping by non-phrase-initial *wh*-phrases in English can be explained in terms of Interface Economy, in the next section, I will, first, discuss what Interface Economy is and how the Interface Economy-based approach to QR can shed light on the observed problems of pied-piping in English.

4. Interface Economy, QR and Pied-Piping

4.1. QR and Interface Economy

Based on work such as Golan (1993) and Reinhart (1993), Reinhart (1995) proposes that some economy conditions can be violated depending on interface needs, unlike the standard derivational economy conditions, which are absolute, i.e., not violable, regardless of interface needs. She calls this kind of economy Interface Economy and claims that QR is an operation motivated by it. The motivations for this claim are based on the following considerations.

Reinhart (1995) notes that in general, the scope of QPs is their overt *c*-command domain, if we set aside existential wide scopes, and that the cases where strong quantifiers like *every* take non-overt scope are highly marked, although not impossible.¹⁵⁾ Reinhart further notes that the locality conditions holding of QR involved in existential NPs and strong NPs are completely different and more importantly that neither conforms to the standard movement localities. The scope of existential NPs seems to be completely insensitive to syntactic structure (*c*-command) and movement constraints (Subjacency) while the scope of strong quantifiers is highly restricted, being clause-bounded. Based on the fact that there are no other A'-movement operations which show these properties and that QR has another theoretical problem of having no morphological

14) Note that I am saying that only 'certain' instances of covert *wh*-movement to the Spec of pied-piped XP are QR. It is because there can be cases where the *wh*-phrase moves to the Spec of XP by some independent feature checking movement, not by QR. I will claim that PP pied-piping is such a case. See section 5.2. for the discussion on PP pied-piping.

15) A similar suggestion was made by Kayne (1994).

motivation at all for movement, Reinhart claims that the quantifier scope interactions should require special operations which are different from other standard movement operations.

For existentials, she proposes that their scope is not captured by a movement operation like QR but by a completely different operation applying choice functions. As for the scope of strong quantifiers, she proposes that they do involve movement like QR but that this movement is an operation not allowed in the computational system but motivated by interface considerations, i.e., to yield an interpretation that is not available without QR. According to this approach, QR is always a case of economy violation at the computational system, but the result obtained by QR may sound optimal if using the uneconomical derivations is the only way to satisfy certain interface needs. In this approach, the markedness of the construction resulting from QR follows from the fact that QR violates the economy condition of the computational system, whether it is motivated by interface needs or not. Specifically, Reinhart suggests that the markedness of the construction involving QR might be attributed to the processing complexity resulting from comparing the derivations.

4.2. Parallels between QR and Covert Wh-movement Involved in Pied-Piping

4.2.1. Basic Similarities

In the analysis of pied-piping proposed in this paper, in order for a wh-phrase to pied-pipe the constituent containing it, it must be in the Spec of the pied-piped constituent. For the instances of pied-piping by non-phrase-initial wh-elements, it means that the wh-phrase must move covertly to the Spec of the pied-piping phrase. One question that comes to mind in this analysis is the nature of the covert Wh-movement to the Spec of pied-piping XPs. Obviously, it is not a feature checking movement and in most cases, it is also difficult for it to be viewed as a Subjacency-driven movement, at least in the standard sense. For example, in order for a DP like *pictures of whom* to be pied-piped as in the following sentence, the wh-phrase *whom* must move to the Spec of DP and percolate its wh-feature to the DP.

- (36) The man, [whom_i pictures of t_i]^{wh} I saw t_j in newspaper yesterday, is here.

The moved *wh*-phrase *whom* in (36) does not check any feature in the Spec of DP and given the standard assumption that extraction out of a DP need not pass through its Spec, this movement is not motivated by Subjacency or its more recent version, *Phase Impenetrability Condition* (Chomsky 1998).¹⁶⁾

In addition, this movement differs from other movements in that it can be optional. This can be immediately seen from the optionality of PP pied-piping in general and some instances of pied-piping in appositive relative clauses as in (37-38).

- (37) a. the man, [afraid of whom] John is, ...
 b. the man, [whom] John is afraid of, ...
- (38) a. the man, [pictures of whom] John saw on the magazine, ...
 b. the man, [whom] John saw pictures of on the magazine, ...

If movement is involved in pied-piping, the difference between pairs of sentences like (37a-b) and (38a-b) can be explained by assuming that this movement is optional: if the *wh*-phrase covertly moves to the Spec of AP/DP and percolates its *wh*-feature, then we get pied-piping as in (37a) and (38a), while if there is no movement, then, there is no pied-piping, as in (37b) and (38b).¹⁷⁾

An interesting thing about these properties manifested by the covert *Wh*-movement involved in pied-piping is that they are exactly the same kinds of properties manifested by QR. As already discussed, QR is not a movement motivated for feature checking and it is optional.¹⁸⁾

16) Basically, what this condition says is that only the Spec and the Head of a phase/cycle is visible for outside operations and thus any element which is to move out of the phase/cycle must be in its Spec. In short, the *Phase Impenetrability Condition* induces a strong form of Subjacency by requiring that movement target the edge of every phase.

17) The optionality of pied-piping does not necessarily show the optionality of covert *Wh*-movement involved in pied-piping. It is because as we have already seen, we have to assume that feature percolation is optional, given the data as in (27-28) in Basque and Imbabura Quechua which show that clausal pied-piping is optional.

18) This is not true in some of the recent approaches to QR such as Hornstein (1995) or Beghelli & Stowell (1997). In Hornstein, there is no independent QR but QR-like effects are

4.2.2. QR and Markedness

Another interesting property which is shared by both QR and the covert movement involved in pied-piping is that the grammaticality of constructions involving these movements is both highly marked. As for QR, the fact that the scope of QPs is generally their overt c-command domain and the cases where strong quantifiers like *every* take non-overt scope are highly marked was one of the strong motivations for Reinhart to propose that QR is an operation not allowed in the computational system but motivated by interface needs.

The observation that QR, at least, certain cases of QR, is a marked operation was also made in Kayne (1994, p. 135) concerning the inverse linking constructions as in (39) (May, 1985). Kayne notes that the bound variable reading in (39a), where the quantifier *every* does not overtly c-command the variable it binds is somewhat marginal unlike that in (39b) where the quantifier *every* is in the Spec of DP on the surface and thus overtly c-commands the pronoun it binds. Based on this, he suggests that a kind of LF movement which May (1985) posited ((40)) in order to explain the bound variable reading in (39a) might be too powerful.

- (39) a. ?Somebody from every city_i despises it_i.
 b. Every girl's_i father thinks she_i is a genius.

- (40) [_{NP} Every city_i [_{NP} somebody from t_i]], [_S t_i despises it_i]

Since directly adjoining the QP *every city* to IP in (39a) will violate the Subject Island Condition, May proposed that the QP, first, adjoins to the subject NP and then to S. Note that the structure of NP (i.e., DP in the current theory) in (40) is very similar to that of the pied-piped NP as in sentences like (41a), given the analysis of pied-piping proposed in this paper.¹⁹⁾

captured, parasitically, by independently motivated A-movement. In Beghelli & Stowell, QR is a feature-checking movement. They claim that a quantifier like *every* moves to the Spec of Distributive Projection to check its [dist]-feature.

19) The only difference between the two is that position occupied by the quantifier *every* in (40) is usually assumed to be an adjoined position whereas the position I have assumed so far to be occupied by the covertly moved wh-phrase in (41) is the Spec. I will come back to this in section 4.3.

- (41) a. the man, [pictures of whom] I saw on the magazine,
 b. the man, [_{DP} whom_i [_{D'} pictures of t_i]] I saw on the magazine

Furthermore, pied-piping constructions like (41a) show the same kind of markedness we observe in inverse linking constructions like (39a). Although sentences like (41a), which involve pied-piping by a non-phrase-initial wh-element, are not ungrammatical in appositive relative clauses, stylistically, they are still somewhat marked.²⁰⁾ The marked flavor attached to (41a) is more clearly seen, when we compare the grammaticality status of (41a) with that of (42a-b), which involve pied-piping by phrase-initial wh-elements.

- (42) a. [Whose book] did you read?
 b. [How proud of her] are you?

In the present analysis of pied-piping, this difference between (41) and (42) can be reduced to the fact that pied-piping by a non-phrase-initial wh-element as in (41a) involves QR, unlike pied-piping by a phrase-initial wh-element as in (42).

In short, given the analysis of pied-piping proposed in this paper, the contrast between (41) and (42) is the same kind of contrast found in (39a-b). The marked flavor attached to both the inverse linking constructions and the cases of pied-piping by non-phrase-initial wh-elements thus provides us with one more piece of evidence that the covert movement involved in pied-piping by non-phrase-initial wh-elements is QR and furthermore, that QR is an operation motivated by interface needs. According to Reinhart (1995), markedness is a hallmark of an operation motivated by Interface Economy.

A similar explanation can also be extended to the variation in native speakers' grammaticality judgments for sentences involving most cases of pied-piping by non-phrase-initial wh-elements.²¹⁾ I propose that the variation in grammaticality judgments derives from the fact that these

20) Markedness attached to this kind of pied-piping was one of the motivations that made Webelhuth (1989) exclude this kind of pied-piping in relative clauses from the general phenomenon of pied-piping.

21) It is not the case that all instances of pied-piping by non-phrase-initial wh-elements show variability of grammaticality judgment. PP pied-piping is such a case. I will provide an explanation for this in section 5.2.

sentences involve QR, an operation motivated by interface needs of individual speakers. We can easily surmise that the application of an interface-motivated operation, by its very nature, will be different from that of other obligatory syntactic movements motivated by morphological feature checking, being more sensitive to what was intended by individual speakers. This means that there could be more room for variation in native speakers' judgment for the grammaticality of these sentences.

I think that this proposal can capture the essence of Emonds' (1976) claim that pied-piping by non-phrase-initial wh-elements in questions and restrictive relative clauses belongs to the stylistic component. His main arguments for this claim were the variation in native speakers' judgments on this kind of pied-piping and the marginal acceptability of sentences involving it. What I am proposing instead is that these special properties can be explained if pied-piping by non-phrase-initial wh-elements involves QR and that QR is a special rule motivated by interface needs. In short, given the analysis of pied-piping proposed in this paper, it is not an accident that the cases of pied-piping for which native speakers show variation in grammaticality judgments in English are mainly those cases where an XP is pied-piped by a non-phrase-initial wh-element.

4.3. Feature Percolation Revisited

In section 4.2., we have seen that inverse linking constructions show parallel behavior to pied-piping by non-phrase-initial wh-elements and that this is expected given the analysis of pied-piping proposed in this paper. In fact, the only difference between the structure May posited for inverse linking constructions ((43)) and the one I have proposed for pied-piping by non-phrase-initial wh-elements ((44)) is that the position occupied by the quantifier *every* in (43) is an adjoined position, whereas the position I have assumed, so far, to be occupied by the covertly moved wh-phrase in (44) is the Spec.

(43) [_{DP} Every city_i [_{DP} somebody from t_i]_j] [_{IP} t_j despises it_i]

(44) the man, [_{DP} whom_i [_{D'} pictures of t_i]_j] I saw t_j on the mantelpiece,

This difference in structural positions occupied by quantifiers in inverse

linking constructions and by *wh*-phrases in pied-piping constructions, in turn, raises a question concerning the exact position to which the *wh*-phrase moves in the pied-piping XP and ultimately, the positions from which features can percolate to the dominating node. As we have already noted, the standard assumption about this position is that it is the Spec of the pied-piped XP. However, if the covert movement of *wh*-phrase involved in pied-piping is QR, the claim that *wh*-phrase must move into the Spec of XP in order to be a pied-piper seems to be inconsistent with the standard assumption that QR is an adjunction operation.

In addition, sentences like the following in English suggest that the position to which the *wh*-phrase moves in the pied-piping XP cannot always be taken as the Spec.

- (45) a. the city, [my pictures of which] was published in the recent magazine,
 b. the city, [some politicians from which] came to Washington yesterday

If we assume that the possessor and quantifier *some* are in the Spec of DP, then we have to say that the *wh*-phrase has adjoined to the DP. This conclusion, of course, is not conclusive, given that there always is a possibility for the availability of an extra Spec position of another layer of functional projection to which the *wh*-phrase can move into, if we assume a more articulated nominal structure (Kayne, 1994, etc.). Note, however, that given the approach to QR I am taking, where QR is not a feature checking operation, it is more natural to take QR as adjunction rather than as movement into Spec.

Based on these considerations, I propose to revise the feature percolation mechanism to the effect that feature percolation is possible from an adjoined position as well as the Spec. This proposal is consistent with the structure of phrases proposed by Kayne (1994), in which adjoined positions and Spec are not distinguished structurally. This revision of feature percolation is not inconsistent with the existing pied-piping data, either, since the claim that features can percolate from the head and Spec but not from the complement and/or adjoined positions (modifiers) is mostly based on the surface positions *wh*-phrases occupy within a pied-piped XP, under the analysis which does not posit any kind of covert *Wh*-movement to the Spec of pied-piping XP (e.g.

Webelhuth, 1989). In short, what I am proposing is that feature percolation is possible whenever the *wh*-phrase is in a position sufficiently high in the structure and that adjoined positions as well as Spec meet this condition.

4.4. Summary

To summarize, I have shown that the covert movement of *wh*-phrases I have proposed for certain instances of pied-piping by non-phrase-initial *wh*-elements in English shares many unique properties with QR. The simplest and most natural explanation for these similarities, of course, is to assume that it really is QR. That *wh*-phrases can move by QR is not surprising at all, given that *wh*-phrases indeed are quantifiers. What I am proposing is that *wh*-phrases in English that do not move overtly move by QR, not by a feature-checking *Wh*-movement. This means that *Wh*-movement in English can only be overt and that there is no covert *Wh*-movement in English. This seems to be a natural conclusion, if we interpret the fact that the [+*wh*]-feature of C is strong in English in a more literal sense.²²⁾ Assuming that certain instances of pied-piping in English involve QR²³⁾ and furthermore, that QR is an operation motivated by Interface Economy, in turn, can help explain other properties of

22) This conclusion is necessary given the data about clausal pied-piping as in (15). In section 5.3, I will claim that the pattern of clausal pied-piping in English can be explained in terms of the clause-boundedness of QR. Note, however, that I am not saying that covert movement of *wh*-phrases is QR in all languages. I propose that in *wh*-in-situ languages like Korean and Japanese, where the *wh*-feature of C is weak, covert movement of *wh*-phrases can be *Wh*-movement. This will explain the fact that large scale pied-piping, including clausal pied-piping, is possible in languages like Korean and Japanese, just like in overt *Wh*-movement languages like Basque or Imbabura Quechua (Choe, 1987; Nishigauchi, 1992, etc.). Given that the impossibility of clausal pied-piping in English is due to the clause-boundedness of QR or a language-specific filter like the DFC filter (see footnote 28), it is expected that clausal pied-piping will be possible in cases where neither condition holds.

23) The same claim was made by Ishihara (1984), although he failed to capture the full range of pied-piping data. For example, he could not explain the impossibility of pied-piping finite clauses as in (i) below.

(i) *The haunted house, that the authorities should condemn which seems reasonable, is just down the street. (Ishihara, 1984, p. 405)

This is expected given that he did not take into account the unique locality condition of QR, i.e., the so-called clause-boundedness of QR, despite the fact that he was assuming that a QR-like operation is involved in pied-piping in English. In section 5.3, I will show how the above data can be explained in terms of the unique locality condition of QR distinct from that of other *A*-movements.

pied-piping in English. This will be picked up in the next section.

5. QR and Explaining Pied-Piping in English

5.1. Pied-Piping in Different Types of Clauses

5.1.1. Pied-Piping in Questions vs. Pied-Piping in Relative Clauses

If the covert movement I have proposed as being involved in pied-piping by non-phrase-initial wh-elements in English is QR and QR is motivated by interface needs, the differences between pied-piping in questions and relative clauses can be explained in the following way. First, I propose that the less constrainedness of pied-piping in appositive relative clauses can be explained, if we consider the fact that the fronted wh-elements in appositive relative clauses can be interpreted as a topic, as already noted by Emonds (1979). For example, what acts as a kind of topic of the relative clause in (46a) below is *pictures of whom*, while it is *whom* in (46b).

- (46) a. the director, pictures of whom I saw so many times
 b. the director, whom I saw pictures of so many times

This difference in topic interpretation in the relative clause is comparable to the difference observed in (47a) and (47b).

- (47) a. Pictures of Spielberg, I saw so many times.
 b. Spielberg, I saw pictures of so many times.

In short, what I am suggesting is that sentence (46a) where the DP *pictures of whom* was pied-piped and (46b) where there was no pied-piping can be taken to have two different interpretations. I propose that it is this semantic difference that makes pied-piping in appositive relative clauses as in (46a) acceptable despite the fact that pied-piping in this case involves a movement operation not allowed in the computational system, i.e., QR of the wh-phrase to the Spec of DP. Although this movement is not allowed in the computational system, it is made possible by an interface need, i.e., to yield a different interpretation not available without it.

Now let us turn to why the same kind of pied-piping is not allowed in questions and/or restrictive relative clauses. I propose that it is because topic interpretations are not possible for the fronted elements in these clauses. As for Wh-questions, fronted wh-phrases cannot be interpreted as topics, since question words, being new information, cannot be interpreted as the topic of a sentence.

- (48) a. *?Pictures of whom did you see?
 b. Whom did you see pictures of?

Given that pied-piping by non-phrase-initial wh-elements as in (48a) involves QR, this means that this kind of pied-piping will not be possible in questions. To be more specific, assuming that “If at the stage of translating a given convergent derivation *D* into some semantic representation, we discover that an equivalent semantic representation could be obtained by a more economical derivation *D'*, *D'* blocks *D*.” (Reinhart, 1995, p. 51), we can say that the more economical derivation without QR and the subsequent pied-piping in (48) blocks the less economical one with QR and pied-piping in (48a).

A similar explanation can be extended to pied-piping in restrictive relative clauses, on which, as I have noted, there have been some disagreements among researchers. As we have already seen, researchers like Webelhuth (1989) assumed that restrictive relative clauses pattern with appositive relative clauses in that pied-piping by non-phrase-initial wh-elements is possible in them, while Emonds (1979, 1985) claimed that there is a contrast in pied-piping in appositive relative clauses and restrictive relative clauses. Until now, I have ignored the question of which should be the correct characterization, but now it seems that the notion of Interface Economy can shed light on this problem. It suggests that restrictive relative clauses should pattern with questions rather than with appositive relative clauses, confirming Emonds’ observation. This is for the following reasons.

In order for the pied-piping by a non-phrase-initial wh-element to be possible in restrictive relative clauses, the pied-piped XP must be able to be interpreted as the topic of the restrictive relative clause. This, however, is not possible, considering the fact that restrictive relative clauses in general do not allow a thematic topic in them. Ultimately, this can be attributed to the fact that thematic topics are allowed only in root

clauses and that restrictive relative clauses are dependent clauses. In short, given the analysis of pied-piping utilizing QR and the notion of Interface Economy, pied-piping by non-phrase-initial *wh*-elements is predicted to be impossible in restrictive relative clauses, just as in questions. There is no semantic difference between a sentence which involves pied-piping and one which does not, and consequently, a more economical derivation without pied-piping will block the derivation with pied-piping.

The conclusion that restrictive relative clauses should pattern with questions rather than appositive relative clauses with respect to pied-piping by non-phrase-initial *wh*-elements seems to be consistent with the grammaticality judgments of many native speakers on pied-piping. Granting some variation, in general, sentences involving pied-piping by non-phrase-initial *wh*-elements are judged to be better in appositive relative clauses than in restrictive relative clauses and questions.²⁴ As for the reportedly well-formed instances of pied-piping by non-phrase-initial *wh*-elements in restrictive relative clauses such as (49) below, note, that these sentences are not judged to be fully grammatical by everybody. Thus, unlike in Ross, sentences like (49a) are judged to be marginal by Emonds (1976).²⁵

- (49) a. Reports [the lettering on the covers of which] the government prescribes the height of are a shocking waste of funds. (Ross, 1967, p. 109).
 b. an opera [the last three bars of the overture of which] contain a fiendishly difficult part. (McCawley, 1988, p. 436)
 c. This is the kind of woman [proud of whom] I could never be. (Webelhuth, 1989, p. 129)

Given this, a possible explanation would be to assume that the relative

24) In addition, it also lends further support, although indirect, to the conclusion that most of the data on pied-piping by non-phrase-initial *wh*-elements discussed in the literature on pied-piping involve appositive relative clauses.

25) Examples like the following are given in Emonds (1976).

- (i) a. ?Students the height of the lettering on whose jackets the administration prescribes almost always rebel.
 b. ?The boy the employer of whose guardian we elected president ratted on us. (1976, p. 186)

clauses in these cases were derivatively generated on the model of appositive relative clauses, as suggested by Emonds (1985, p. 304). We have already seen in (5) that if the possibility of a relative clause being interpreted appositively is low due to the choice of the head of the relative clause, pied-piping becomes more difficult.

Before I close this section, let me note that the proposed explanation for the differences between pied-piping in questions and restrictive relative clauses on the one hand and appositive relative clauses on the other does not suffer from the problems that arise in the Topicalization approach of Emonds and Webelhuth. Although I have appealed to the availability of a topic reading in appositive relative clauses, note that the fronting of an XP containing the *wh*-phrase in appositive relative clauses is by pied-piping *Wh*-movement, not by Topicalization. In my analysis, the availability of a topic reading makes a difference since what allows that pied-piping movement is the intermediate step of QR, which is motivated by interface needs.

5.1.2. Pied-Piping in Matrix Questions vs Pied-Piping in Embedded Questions

Interface economy can also shed light on another frequent observation about pied-piping in English, namely, that pied-piping is easier in matrix questions than in embedded questions ((50) vs. (51)).

- (50) a. *I asked Bill [pictures of whom] he saw on the mantelpiece.
 b. *I asked Bill [proud of whom] he has always been.
- (51) a. ??[Pictures of which actor] do you like most?
 b. ??[Proud of whom] has he always been?

As already noted, a common explanation for this difference has been that it is because there is a possibility that these kinds of matrix questions involving pied-piping can be interpreted as an echo question unlike the embedded questions (Cowper, 1987; Kayne, 1994).

Note, however, that it has never been spelled out exactly how an echo question reading is possible for sentences like (51) involving pied-piping and how the availability of an echo question reading makes a difference for pied-piping. Given that the general assumption about echo questions is that *wh*-phrases do not move, one way to implement the idea could be, again, to say that the overt fronting of the phrase containing the

wh-phrase in (51) does not involve pied-piping Wh-movement but some other means. Just as in appositive relative clauses, a strong candidate we might want to appeal to as an alternative means of fronting is Topicalization. This, however, is not plausible for various reasons. First, question words, as we have already seen, cannot be interpreted as topics. Secondly, the Subject-Aux Inversion clearly indicates that the sentence involves Wh-movement, not Topicalization. This means that even if the observation that pied-piping is easier in matrix questions than in embedded questions due to the availability of echo question reading is correct, it remains to be explained why the availability of an echo question reading for the pied-piped constituent makes a difference.

The notion of Interface Economy, again, can provide an explanation. Let us assume that QR of a wh-phrase to the Spec of DP and the subsequent pied-piping movement of DP to the Spec of CP makes available an interpretation which is not available when there was no QR and no pied-piping, namely, an echo question reading. If so, then we can say that QR is justified by an interface need, i.e., a need to yield an echo reading. Concerning how pied-piping makes an echo question interpretation possible in matrix questions, we could say that the lack of overt movement of the wh-phrase inside the larger phrase containing it somehow makes the echo reading more accessible. For example, in (51), although the DP containing the wh-phrase overtly moved to the clause-initial position, DP-internally, the wh-phrase stays in the original position on the surface. Embedded questions differ, since echo question interpretations are not available for embedded questions in general. This means that QR cannot be motivated by an interface need in embedded questions like (50) and consequently, pied-piping cannot take place. In short, the analysis of pied-piping based on Interface Economy can provide an explanation for why pied-piping is easier in matrix questions than in embedded questions.

5.2. PP Pied-Piping

One apparent problem with the proposed explanation for the differences in pied-piping in different types of clauses in terms of Interface Economy is PP pied-piping. PP pied-piping is fully grammatical even in questions and restrictive relative clauses, unlike comparable DP or AP pied-piping. This is not expected if PP pied-piping involves QR of a wh-phrase to the Spec of PP. Given that QR is an operation motivated by interface needs,

applying it should yield an interpretation otherwise not available. PP pied-piping in questions and restrictive relative clauses, however, does not differ much from DP or AP pied-piping in that it does not yield any visibly different interpretations. I propose the following explanation for this problem.

Let us assume that Spec of PP is the position where the complement of P checks its Case feature. If this is the case, the *wh*-complement of P in English must move, covertly, to the Spec of PP, independently of interface needs. Once it gets there, it can percolate its *wh*-feature and as a result, the whole PP can be pied-piped. In short, in the case of PP pied-piping, the *wh*-complement of P moves to the Spec of PP for independent feature checking permitted in the computational system, not for an interface need as in the pied-piping of DPs or APs.²⁶⁾ This means that PP pied-piping will not show any sign of markedness resulting from applying an interface-motivated movement operation.²⁷⁾

One important prediction of the present proposal is that pied-piping will show markedness only when QR is involved. Thus, although any phrase whose Spec or adjoined position is filled by a *wh*-phrase can be pied-piped, only the pied-piping involving QR will manifest the marked grammatical status. This prediction seems to be borne out. We have already seen that pied-piping by a *wh*-phrase base-generated in the Spec does not show any kind of marked flavor. Likewise, no trace of markedness is observed when the *wh*-phrase moves to the Spec of XP by feature checking A or A'-movement. For A'-movement, clausal pied-piping in languages like Basque or Imbabura Quechua ((21)-(22), repeated as (52-53) below) is an example. As we have already seen, when an

26) This explanation is very similar to the approach taken by Hornstein (1995) in order to explain quantifier scope interactions, although I am not taking his view of QR.

27) As an alternative explanation, we might assume that movement out of PP must employ its Spec as an escape hatch (van Riemsdijk, 1982). Van Riemsdijk argues that "PPs behave like syntactic islands in many constructions," based on the fact that it is easier to extract elements from a PP if the PP is closely connected with the verb. The contrast between the following two sentences shows this.

(i) a. Whom_i did you talk [_{PP} to t_i]_j?

b. *[Which break]_i should we leave [_{PP} during t_i]_j? (van Riemsdijk, 1982, pp. 144-145)

In order to explain this, he claims that licit movement from PP proceeds through an escape hatch within PP, which will be Spec of P under the current theory. If this is the case, the movement of *wh*-phrase to the Spec of PP, again, is not motivated by interface needs, and thus pied-piping of PP by a non-phrase-initial *wh*-element will not show the marked status attached to DP or AP pied-piping of the same kind.

embedded CP is pied-piped, the *wh*-phrase must move to the Spec of the CP containing it. This movement is driven by Subjacency and the resulting pied-piping, thus, does not show any markedness.

- (52) [Nor etorri d-ela] esan du Mirenek uste du-ela Jonek?
 who come aux-that said has Mary think aux-that John
 'That who has come has Mary said (that) John thinks?'

- (53) [Ima-ta Juan randi-shka]-ta-taj pro ya-ngui?
 what-ACC Juan buy-NML-ACC-Q (you) think-2
 'What do you think that Juan bought?'

For feature checking A-movement, PP pied-piping in English fits the bill. In PP pied-piping, the *wh*-complement of P moves to the Spec by Case-checking A-movement and thus does not show any marked flavor.

An interesting prediction of this explanation for PP pied-piping in English is that when movement involved in PP pied-piping is not motivated by Case-checking, the resulting pied-piping will be ungrammatical/highly marked on a par with DP or AP pied-piping by non-phrase-initial *wh*-elements. A potential candidate for this case is an adjunct clause headed by a preposition as in (54a) below.

- (54) a. *?I wonder [without meeting whom] Mary left.
 b. I wonder [_{PP} without [_{CP} [_{IP} PRO meeting whom]]] Mary left.

Assuming that the structure of (54a) is (54b), in order for the adjunct clause to be pied-piped, the *wh*-phrase *whom* must move to the Spec of PP. Note, however, that unlike in other cases of PP pied-piping, the *wh*-phrase is already Case-marked by the verb, *meet*, and thus it need not move to the Spec of PP for Case-checking. This means that *whom* in this case can move to Spec of PP only by QR, not by Case-checking movement. Given that QR and the subsequent pied-piping in this case, being in embedded questions, does not produce any semantic differences, it is predicted that pied-piping of the PP in (54a) should be ungrammatical/highly marked on a par with DP or AP pied-piping by non-phrase-initial *wh*-phrases. This prediction is borne out, as we can see from the ungrammaticality/marginality of (54a), in contrast to other cases of simple PP pied-piping. That this explanation is on the right track is

further evidenced by the acceptability of the comparable pied-piping in appositive relative clauses.

(55) Mr. Smith, [without meeting whom] Mary left, is a great poet.

The acceptability of (55) is expected, since QR in this case can be motivated by an interface need, i.e., by the availability of topic interpretation for the pied-piped constituent.

5.3. Clausal Pied-Piping and the Locality of QR

5.3.1. Restrictions on Clausal Pied-Piping and Clause-boundedness of QR

As we have already noted, pied-piping finite clauses and non-finite clauses with an overt subject is impossible even in appositive relative clauses ((56b-c)), while pied-piping non-finite clauses without an overt subject is possible ((56a)).

- (56) a. The elegant parties, [to be admitted to one of which] was a privilege, had usually been held at Delmonico's.
 b. *The elegant parties, [for us to be admitted to one of which] was a privilege, had usually been held at Delmonico's.
 c. *They bought a car, [that their son might drive which] was a surprise to them.

Given the analysis I have proposed in this paper, the above data can be explained in terms of the unique locality of QR, i.e., the so-called clause-boundedness of QR. To be more specific, under the present analysis of pied-piping, in order for a clause to be pied-piped, the *wh*-phrase must move to its Spec covertly and percolate its *wh*-feature to the CP, as illustrated in the following structures.

- (57) a. The elegant parties, [which PRO to be admitted to one of t] was a privilege, had usually been held at Delmonico's
 b. *The elegant parties, [which for us to be admitted to one of t] was a privilege, had usually been held at Delmonico's
 c. *They bought a car, [which that their son might drive t] was a surprise to them.

I propose that what is wrong about (57b-c), in contrast to (57a), is the fact that the covert movement involved in this derivation violates the clause-boundedness of QR, pending a more precise characterization of the 'clause.'²⁸ The fact that the pattern in the possibility of getting a wide scope reading for the QP *every party* in (58) closely parallels that of clausal pied-piping by non-clause-initial wh-elements in (56) suggests that the explanation for the pattern of clausal pied-piping in English as in (56) in terms of the clause-boundedness of QR is on the right track.

- (58) a. Somebody prefers to attend every party.
 b. Somebody prefers (for) Bill to attend every party.
 c. Somebody believes that Bill attended every party.

In (58), the possibility of getting a wide scope reading for the QP *every party* degrades as we move from (58a), where the QP is in a non-finite CP without a lexical subject, to (58c) where the QP is inside a finite clause.

The preceding explanation, of course, is not sufficient, since it only shows that the same kind of locality is shared by QR and the covert movement involved in pied-piping. What remains to be explained is precisely how the locality of QR can be characterized and explained. Before I embark on this, note that the claim that QR is clause-bounded

28) This explanation is different from the one given in Yoon (2000, 2001). There, sentences like (56b-c) were ruled out in the same way as sentences like (i) below, where the wh-phrase is in the Spec of CP on the surface, were ruled out.

- (i) a. *They bought a car, [which that their son might drive] was a surprise to them.
 b. *The elegant parties, [which for us to be admitted to one of] was a privilege, had usually been held at Delmonico's.

Since the overt movement of wh-phrase to the Spec of CP in this case is a regular successive cyclic Wh-movement, pied-piping as in (i) should be, in principle, possible in English, just like in Basque or Imbabura Quechua. Pied-piping as in (i), however, can be ruled out, since it violates the DFC Filter. The same explanation in terms of the DFC Filter was also proposed by Ortiz de Urbina (1993). In addition to the conceptual difficulties of applying the DFC filter to covert material, an unnoticed problem with extending the same explanation to sentences like (56b-c) is the ungrammaticality of sentences like (ii) below.

- (ii) *John bought a car, [to believe [that his wife wants which]] was absurd.

Since the covert movement of *which* to the Spec of infinitival CP does not violate the DFC filter, sentence (ii) should be good if the ungrammaticality of (56b-c) is due to a violation of the DFC filter. The ungrammaticality of (ii), however, can be easily explained in terms of the clause-boundedness of QR.

was never actually established, as pointed out by Reinhart (1995). So although QR is not possible outside of finite clauses, it is clearly possible outside of ECM clauses ((59a)) and not impossible in infinitival clauses ((59b)).

- (59) a. Somebody believes everybody to be smart.
b. Somebody wants to go to every party.

QR is also possible outside finite clauses, when the clause is interrogative, as we see in (60).

- (60) John told somebody what everybody bought.

This means that QR in these cases is not clause-bounded. This kind of non-clause-bounded QR, however, is generally not possible or more difficult when the embedded clause is a declarative finite clause or when it is a non-finite clause with an overt subject, as we have seen in (56b-c) and see in the following examples.

- (61) a. John told somebody that everybody bought a book.
b. Somebody believes Mary to have gone to every party.

However, in some cases, non-clause-bounded QR is possible even when the QP is inside a declarative finite clause, as we see in the following example.

- (62) Who do you think everyone saw at the rally?

The QP *everyone* in (62) can have a wide scope reading even though it is inside a declarative finite clause.

The preceding discussion shows that it will not be easy to come up with the precise locality domain of QR. Although a comprehensive account for this is beyond the scope of this paper, I suggest that Fox's (1995, 2000) proposal in terms of Scope Economy and Shortest Move can shed some light on this matter.

5.3.2. Scope Economy (Fox, 1995, 2000) and Deriving the Locality of QR

Fox proposes that scope-shifting operations like QR are "allowed to

apply only when they are necessary to achieve a designated semantic interpretation.”

(63) Scope Economy

Scope-shifting operations (SSOs) cannot be semantically vacuous. (Fox, 2000, p. 3)

What this condition says, in a nutshell, is that semantically vacuous applications of QR that reverse the relative scope of two QPs are not allowed. For example, in “scopally informative” sentences like (64a) below, the interpretation is different depending on whether the subject takes scope over the object or the object over the subject. In contrast, in “scopally uninformative” sentences like (64b), the interpretation is the same regardless of applying QR to *every girl* or not. Fox proposes that QR is not allowed in these cases.

- (64) a. Many boys love every girl. (many $> \forall$) ($\forall >$ many)
 b. John loves every girl.

This claim is based on some facts about the elliptical sentences like (65) below.

- (65) a. A boy admires every teacher.
 b. A boy admires every teacher. Mary does, too. ($\exists > \forall$, $*\forall > \exists$)

A puzzle about sentence (65b) is that unlike (65a), which is ambiguous, the sentence “A boy admires every teacher.” is not ambiguous. Fox proposes that the absence of inverse scope in (65b) can be explained in terms of Scope Economy and the Principle of Parallelism. What Parallelism says is that “in an ellipsis construction the scopal relationship among the elements in B_A must be identical to the scopal relationship among the parallel elements in B_E .” Given this, the absence of inverse scope in (65b) is explained if the second sentence “Mary does <admire every teacher>, too” does not involve QR, due to Scope Economy. If there is no QR, VP2 is not identical to VP1, and consequently the omission of VP2 will be ruled out as a case of Parallelism violation.

- 29) To be more precise, only the optional QR, which is not forced by type considerations, is subject to Scope Economy. This is because Fox, unlike May (1985), is not assuming that all QPs must undergo QR. Instead, he assumes that a QP is a second-order predicate (type $\langle e, t \rangle$, $\langle t, t \rangle$) and when a QP is the sister of a one-place predicate, it need not undergo QR. See Fox (2000) for details.

In (70a), in order for *every man* to take a wide scope over *someone*, it must move out of the embedded clause. This, however, is impossible, given that QR must satisfy both Scope Economy and Shortest Move. Since the closest clause-denoting element for the QP in the subject position of the embedded clause is CP³⁰), Shortest Move dictates that the QP must adjoin to this CP. This movement, however, violates Scope Economy, since it does not lead to any scope changes. In short, given both Scope Economy and Shortest Move, a QP inside a declarative clause cannot take scope outside it.

An interesting prediction of this explanation is that “the locality of QR would be obviated in cases where movement to each intervening XP is motivated by Scope Economy” (Fox, 2000, p. 63). QPs in interrogative clauses show that this prediction is borne out. As an example, in sentences like (71) below, *everybody* can QR to CP without violating Scope Economy, since QR in this case results in a scope change.³¹⁾

- (71) a. One girl knows what every boy bought for Mary. ($\exists > \forall$, $\forall > \exists$)
 b. One girl knows [_{CP} everybody_i [_{CP} what [_{t_i} bought for Mary]]]
 (Fox, 2000, p. 64)

30) Fox is assuming that VP, IP and CP are clause-denoting elements.

31) The impossibility of a wide scope reading for *everything* in (i) below contrasts with (71a) and is not explained by Scope Economy.

(i) One girl knows who bought everything for Mary.

Note that the contrast between (71a) and (i) is reminiscent of the contrast found in (iia-b) below, which led May (1985) to propose the Scope Principle.

(ii) a. What did everyone buy?
 b. Who bought everything?

Unlike in (iia), *everything* in (iib) cannot have a wide scope reading. Descriptively, we can say that wide scope reading of a universal quantifier is possible only when it c-commands the trace of Wh-movement. Theoretically, however, Scope facts in these sentences are problematic for several reasons. First, wide scope reading in (iia) violates the ECP if we assume that *everyone* QRs to CP. Secondly, it is not explained why *everything* cannot have a wide scope in (iib) if it can QR to CP. One possible explanation for this kind of contrast is to assume that the subject wh-phrase does not undergo any movement but stays in situ and checks the wh-feature of C by being directly governed by +wh-C. If this is the case, the impossibility of a wide scope reading for *everything* can be explained in the following way: adjoining *everything* to IP by QR is impossible, since if so, *everything* in (iib) will intervene between +wh-C and the wh-phrase it should directly govern. In contrast, (iia) does not have the same problem, since *what* in the object position must move to the Spec of CP. The QP *everything* will, first, QR to IP and then to CP. This movement violates neither Scope Economy nor the selectional requirement of +wh-C.

Although not discussed in Fox, another case which bears out the prediction is sentences like (72).

(72) Who_i do you think [_{CP} t_i [_{IP} everyone saw t_i at the rally]?

What is interesting about (72) is that the QP *everyone* can have a wide scope reading even though it is inside the declarative finite clause (cf. (70a)). The non-clause-boundedness of QR in this case, however, can be explained, if we consider the presence of the trace in the Spec of CP. If we assume that this trace counts as a QP, then QR of *everyone* to CP is motivated by Scope Economy. The impossibility of wide scope reading in the minimally different sentence like (73) lends further support to this analysis.

(73) Who thought [everyone was at the rally]?

In (73), there is no trace in the Spec of embedded CP and thus QR of *everyone* to the embedded CP, which is necessary in order for *everyone* to have a wide scope reading, will violate Scope Economy.

Not every aspect of the locality of QR, however, is readily explained in terms of Scope Economy and Shortest Move. For example, Fox notes that cases like (74a-b), where the QP in an infinitival clause and a subjunctive clause can take scope outside its containing clause, are not readily explained in terms of Scope Economy and Shortest Move.³²⁾

- (74) a. Someone expects Sue to marry every boy. ($\exists > \forall$, $\forall > \exists$)
 b. He demanded that we read not a single book. (demand > not a single, not a single > demand) (Fox, 2000, p. 65)

For this, Fox simply entertains a few possibilities such as positing some null modal operators in the embedded clause in sentences like (74) or weakening the Shortest Move condition.

Despite difficulties like this, I believe that Fox's approach to the locality of QR in terms of Scope Economy and Shortest Move is basically on the

32) The native speakers I have consulted report that the wide scope reading of *every boy* in (74a) and *not a single book* in (74b) is very difficult to get. See the discussion below and footnote 34 for possible explanations for this.

right track. As Fox notes, his explanation makes a prediction no other approach to QR makes, namely, that the locality of QR would be obviated in cases where movement to each intervening XP is motivated by Scope Economy, and this prediction is generally borne out, as we have already seen. In addition, the following data also suggest that this prediction is correct. Fox, citing Pesetsky, notes that it is not the case that all non-finite clauses behave the same way with respect to QR.

- (75) a. Someone expects [Sue to marry every man].
 b. Someone believes [Sue to be married to every man]. (Fox, 2000, p. 65)

Fox reports that although judgments are subtle, inverse scope is easier in (75a) than in (75b). Although a wide scope reading is very difficult to get both in (75a) and (75b), this contrast can be explained, as suggested in Fox, if we assume that different verbs select different types of clauses. If so, we can say that there is a null modal operator in clauses selected by verbs like *expect* unlike those selected by verbs like *believe*, and that it is the presence of a modal operator that makes the wide scope of *every man* possible in (75a).

Secondly, the locality of QR is also sensitive to the quantificational nature of the subject of IP.

- (76) a. Somebody wants [John to attend every party].
 b. Somebody wants [a girl to attend every party].

Although the wide scope reading of *every party* over *somebody* is difficult to get in both sentences, it is easier to get in (76b) than in (76a). The only difference between the two sentences is that the subject of the embedded clause is a non-QP in (76a), while it is a QP in (76b), and I propose that it is this difference which is responsible for the contrast in (76a) and (76b). In fact, this contrast is expected given Fox's analysis. Although not explicitly discussed in Fox, one prediction of his proposal is that in order for a QP inside VP to take a scope outside of the containing clause, the subject of that clause must be a QP.³³) This is because given

33) Fox discusses a similar prediction.

(i) a.*A different person said that Sue is married to every man.
 b. A different person said that someone is married to every man. (Fox, 2000, p. 65)

that QR is subject to Shortest Move, the QP must, first, adjoin to VP and then to IP, before it adjoins to CP. QR to VP need not be motivated by Scope Economy since it is forced by type considerations. Subsequent QR to IP and CP, however, must be motivated by Scope Economy, and QR to IP will violate Scope Economy unless the subject of the IP is a QP. This, in turn, means that further movement of QP to CP, which is necessary for the QP to have a non-clause-bounded wide scope, will be blocked. For example, in (76a), QR of *every party* to the embedded IP is blocked since the subject of IP is not quantificational. This means that the QP in (76a) will not be able to have a wide scope reading, even if there is some kind of modal operator at the CP level. Wide scope, however, is possible in (76b), since the subject of the embedded IP is a QP in this case.

The preceding account could also explain the ease of getting a wide scope reading when the subject of the complement clause is PRO, as in (77).

(77) Somebody wants [PRO to attend every party].

Given that PRO is controlled by the QP *somebody*, we can say that QR of *every party* to IP is motivated by Scope Economy. Now if we assume that there is a null modal operator at the CP level, we can explain how *every party* can take a scope over *somebody* in (77).

The pattern of clausal-pied-piping in English provides another striking piece of evidence that the preceding account for the locality of QR is correct. We have already seen that pied-piping a finite clause and a non-finite clause with an overt subject is impossible in English, while pied-piping a non-finite clause without an overt subject is possible. As for the impossibility of pied-piping a (declarative) finite clause, it is readily explained, given that QR of the *wh*-phrase to *that*-clause will not be motivated by Scope Economy, regardless of whether the subject of IP is a QP or not. As for the pied-piping of non-finite clauses, however, the facts seem to be more complicated. The prediction of the present account of QR for the pied-piping of non-finite clauses is that non-finite clauses with a QP subject can be pied-piped, while those with a non QP subject cannot be pied-piped. It is because even if we assume there is some kind of a

He reports that some native speakers he consulted found a contrast between (ia) and (ib).

null modal operator at the CP-level of non-finite clauses, QR of the non-subject *wh*-phrase to IP must be motivated by Scope Economy, too. This prediction is borne out in the grammaticality of pied-piping non-finite clauses without a lexical subject as in (78). Non-finite clauses without a lexical subject have PRO as their subject, and given that arbitrary PRO can be interpreted like an indefinite pronoun 'somebody,' it is expected that *which* can QR to IP without violating Scope Economy.

(78) The parties, [PRO to be admitted to which] was a great honor, ...

Pied-piping of non-finite clauses with a lexical subject, however, seems to be a problem, since the standard judgments in the literature on this kind of pied-piping, as already noted, is that it is impossible across the board. A closer look into the data, however, reveals that there are differences depending on whether the subject of the pied-piped clause is a QP or not.

- (79) a. *?UCLA, [for John to be admitted to which] was a miracle, is in
Los Angeles.
b. UCLA, [for a little kid/any kid to be admitted to which] was a
miracle, is in Los Angeles.

Although the judgments are subtle, pied-piping a non-finite CP with a QP subject as in (79b) yields a better result than pied-piping the same clause with a non-QP subject as in (79a). This is the same kind of difference we have observed in quantifier scope interactions in (76a-b) and thus provides further support to the explanation of the locality of QR in terms of Scope Economy and Shortest Move.³⁴⁾

34) As for the speakers who find it impossible or extremely difficult to get a wide scope reading even in sentences like (76b) and/or to pied-pipe an infinitival clause with a QP subject as in (79b), one possible explanation is to assume that for these speakers, there is no modal operator in non-finite CPs (at least, in some non-finite CPs). This means that even if QR to the IP level is allowed, further QR to CP would not be possible for these speakers. One prediction of this explanation is that the speakers who find the wide scope reading in (76b) and pied-piping in (79b) impossible will also find the same situation in (77) and (78). This prediction seems to be borne out. As for pied-piping cases, some native speakers I have consulted found not much difference between (78) and (79a-b). As for the wide scope reading in (77), although it seems, contrary to the prediction, to be easier in (77) than in (76), there might be an independent explanation: it could be attributed to the fact that (77) could involve some kind of restructuring as a mono-clausal structure. Given

To summarize, the preceding discussion shows that the locality of QR cannot simply be characterized in terms of the size of the domain, but more complex factors should be considered. I have shown how Scope Economy combined with Shortest Move could aid in explaining the dynamic nature of the locality of QR. As for the analysis of pied-piping by non-phrase-initial *wh*-elements, the contrast between pairs of sentences like (77-79) provides another strong piece of evidence that this kind of pied-piping involves QR, as proposed in this paper. Note that this kind of pied-piping data will be extremely difficult to explain without appealing to the dynamic nature of QR locality involved in pied-piping.

6. Scope Economy (Fox, 2000) vs. Interface Economy (Reinhart 1995)

In section 5, I appealed to two types of Interface Economy Conditions in order to explain the properties of pied-piping observed in English. First, I proposed that the different pied-piping possibilities in different types of clauses can be explained if we assume that QR is involved in certain instances of pied-piping in English and that QR is an operation motivated by Interface Economy in the sense of Reinhart (1995). Secondly, I have suggested that the unique locality conditions of QR, which I have claimed to be responsible for the restriction on clausal pied-piping in English, can be captured by the interplay of Scope Economy and Shortest Move proposed in Fox (1995, 2000). Although these two Economy conditions are the same in their spirit in that both claim that certain operations apply only when they are needed to obtain an interpretation otherwise not available, the specifics of the two are not the same. Most importantly, they do not cover the same range of data. The difference between the two is clearly seen when we consider what each condition says about the two properties of pied-piping I explained in terms of Interface Economy.

First, as for the clause-type sensitivity of pied-piping, it is explained by Reinhart's notion of Interface Economy working at the global level but not by Fox's strictly local conception of Scope Economy. To be more specific, recall that what differentiates pied-piping in questions and

that there is no possibility of restructuring for (76b), due to the presence of the overt subject, the difference between (76b) and (77) could be attributed to this difference.

restrictive relative clauses on the one hand and appositive relative clauses on the other is whether the topic reading is possible or not for the fronted constituent, not whether each step of QR leads to different scope possibilities. This means that whether the movement of the *wh*-phrase to the DP-initial position in sentences like (80a-b) below is legitimate or not is determined by the later movement of *pictures of whom* to the Spec of CP and the possibility of interpreting it as a topic. As far as Scope Economy at the local level is concerned, the in-situ *wh*-phrase *whom* in both (80a) and (80b) can QR to the Spec of DP without violating it, assuming that this movement leads to a scope change.

- (80) a. The man, [pictures of whom] I saw in the magazine,
 b. *?I wonder [pictures of whom] he saw in the magazine.

In short, the contrast between (80a) and (80b) cannot be explained in terms of Scope Economy alone. As for the pattern of clausal pied-piping and the locality of QR which is responsible for it, however, they can be derived from Scope Economy combined with Shortest Move but cannot be explained by Interface Economy as proposed in Reinhart.

The upshot of the preceding discussion is that we need both Scope Economy and Interface Economy in order to explain the unique properties of QR and pied-piping involving QR. As a way of incorporating the two notions of Interface Economy, I suggest the following. Note, first of all, that in order to ensure the locality of QR, it is crucial that QR be subject to the condition of Shortest Move. Furthermore, we have to assume that Shortest Move can never be violated, regardless of interface needs. This means that we have to assume that Shortest Move is an economy condition in the computational system, not at the Interface. Now, granting that QR is subject to the condition of Shortest Move, the two notions of Interface Economy as proposed in Fox and Reinhart can be incorporated to produce the desired explanations, if we assume that the condition of Interface Economy should be satisfied both at the local and global level. In short, what I am proposing is to interpret Scope Economy of Fox and Interface Economy as proposed in Reinhart as two different facets of the Interface Economy Condition working at different levels, i.e., the former at the local and the latter at the global level. Specifically, we can say that what the Interface Economy condition does at the global level is to compare the derivations which already satisfy

Interface Economy at the local level (and all other independent principles of grammar) and opt for the most economical derivation.

As an example, let us consider how this interpretation of Interface Economy explains the impossibility of pied-piping a non-finite clause with a non-QP subject as in (79a) and pied-piping in embedded questions as in (80b). First, the ungrammaticality of (79a) is explained, since the QR involved in it violates Interface Economy at the local level. Specifically, movement of *which* from the VP-adjoined position to the IP-adjoined position does not produce any scopal changes, given that the subject, *John*, is not a QP.³⁵

- (81) a. *UCLA, [[_{CP} *which*_i [_C for [_{IP} *t*_i [_{IP} **John** to [_{VP} *t*_i [_{VP} be admitted to *t*_i]]]]] was a miracle], is in Los Angeles.

Secondly, the unacceptability of (80b) is explained, since QR does not satisfy Interface Economy at the global level, although it does satisfy Interface Economy at the local level. It is because the two derivations with or without QR ((82a-b) below) have the same meaning.

- (82) a. *?I wonder [whom_i pictures of *t*_i] ; he saw *t*_i in the magazine.
b. I wonder whom_i he saw pictures of *t*_i in the magazine.

In cases like this, Interface Economy at the global level dictates that the more economical derivation ((82b)) block the less economical one ((82a)), which involves an additional step of QR. Note, however, that the same kind of pied-piping is not ruled out by global Interface Economy in appositive relative clauses like (83a), since (83a), as we have already noted, can have a different interpretation from (83b), i.e., topic reading is possible for the pied-piped DP.

- (83) a. The man, [pictures of whom] I saw in the magazine.,
b. the man, whom I saw pictures of in the magazine, ...

The fact that QR is subject to Interface Economy not only at the local but also at the global level could also provide an explanation for the

35) As already noted (in footnote 29), QR to VP is an obligatory operation motivated by type considerations, and thus is not subject to Scope Economy.

contrast between subject and object DP pied-piping in (21), repeated as (84) below, which was taken as evidence for the last resort nature of pied-piping by Radford (1997).

- (84) a. (?) [Pictures of whose mother] did you think *t* were on the mantelpiece?
 b. *? [Pictures of whose mother] did you see *t* on the mantelpiece?

In the present analysis, the reason pied-piping of a subject DP as in (84a) is grammatical or at least, better than that of object DP is because in the case of subject DP pied-piping, there is no legitimate derivation the global Interface Economy will compare (84a) to: the derivation without pied-piping is ruled out as violating the Subject Island Condition. This means that in cases where extracting a *wh*-phrase alone is not possible, pied-piping will be possible/better, thus partly confirming the intuition that pied-piping is a last resort measure.

Note, however, that this does not mean that any kind of pied-piping will be allowed as long as pied-piping is done as a last resort measure. We have already seen that this is not the case.

- (85) a. *the vase, [because John broke which] she was angry,
 b. *the book, [the author who wrote which] happens to be my brother,

As for the ungrammaticality of these sentences, note that they are ruled out independently of the Interface Economy condition at the global level. Given that feature percolation is a necessary condition for pied-piping and that features can percolate from the Spec or adjoined positions, in order for the *wh*-phrase to pied-pipe the whole island, it must be able to move up to the level of the adjunct clause or the complex NP without violating any syntactic principles/constraints. For the adjunct clause, the *wh*-phrase must move up to PP (headed by *because* in (85a)) over the IP and CP complement of P. This movement, however, is impossible, since it will violate Interface Economy at the local level.

- (86) *the vase, [_{PP} which [_{PP} because [_{CP} *t* [_{CP} [_{IP} *t* [_{IP} John [_{VP} *t* [_{VP} broke *t*]]]]]]] she was angry,

That a QP cannot move out of an adjunct clause is evidenced by the fact that the QP inside an adjunct clause cannot take a scope outside of it. In a sentence like (87) below, *everybody* inside the adjunct clause cannot take a wide scope over *somebody*.

(87) Somebody was angry because John criticized everybody.

As for the pied-piping of complex NPs, in order for a complex NP to be pied-piped, the wh-phrase should QR to the NP (i.e., DP in the current theory). This movement, however, will be impossible, since QR of the wh-phrase to DP, subsequent to QR to the relative clause, will violate the ECP, assuming that N is not a proper governor (Cinque, 1990).³⁶

(88) *the book, [_{DP} which [_{DP} the author [_{CP} t [_{CP} who wrote t]]] happens to be my brother,

The impossibility of QR out of the complex NP, again, is shown by the impossibility of a QP inside a complex NP taking a wide scope outside it, as in the following example.

- (89) a. Somebody made the claim that John read every book Chomsky wrote.
b. Somebody made the claim that everybody read Barriers.

In short, what the ungrammaticality of (85) shows is that Interface Economy as a global condition cannot save the structures which already violate other independent principles/constraints of grammar. What it does is to compare the well-formed derivations with the same meaning and block the less economical one(s).

7. Conclusion

In this paper, I have shown how different patterns of pied-piping

³⁶) I am assuming that QR to CP does not violate Scope Economy due to the presence of the relative pronoun *who* in the Spec of CP. Assuming that it is a QP, QR of *which* to the relative CP will not violate Scope Economy.

observed in different types of clauses in English can be given a unified explanation, without excluding any of them from the general mechanism of pied-piping. Based on cross-linguistic data from languages like Basque and Imbabura Quechua showing that the *wh*-phrase must move to the initial position of pied-piped constituents, I have claimed that pied-piping is the result of feature percolation and that feature percolation is possible only from certain structural positions which are sufficiently high inside a phrase. One interesting prediction of this analysis under the Cyclic Spell-Out model is that an XP can be pied-piped by a *wh*-element which is not in its initial position on the surface but moves into it covertly. I have claimed that this is what underlies pied-piping by non-phrase-initial *wh*-elements in English. Assuming further that the covert movement of the *wh*-phrase involved in certain cases of pied-piping by non-phrase-initial *wh*-phrases in English is QR and that QR is an operation motivated by Interface Economy, I have shown how various properties manifested by this kind of pied-piping can be explained. More specifically, by assuming that the condition of Interface Economy should be satisfied both at the local and global level, I have explained why pied-piping by non-phrase-initial *wh*-elements yields less-than-perfect results except in appositive relative clauses and why clausal pied-piping is restricted in English unlike in other languages.

The analysis of pied-piping in English based on QR and the unique nature of QR as an operation motivated by Interface Economy, I believe, has some advantages over other approaches. First, it can provide a principled explanation for different patterns of pied-piping manifested in different types of clauses in English without simply excluding any of them from the pied-piping phenomenon or even from the proper grammar. Secondly, it can capture other problematic aspects of pied-piping by non-phrase-initial *wh*-elements, such as the markedness and the variability in grammaticality judgments. Third, it fits better the general picture of cross-linguistic variation in pied-piping. We have seen that given the kind of analysis drawn from the cross-linguistic variation in pied-piping, pied-piping by non-phrase-initial *wh*-elements should be not only possible but it should be a norm, rather than an exception. This means that what has to be explained is not why this kind of pied-piping is possible in certain clauses like appositive relative clauses in English, but why it produces less-than-perfect results in other types of clauses. I was able to provide an answer to this question by identifying the covert

movement involved in pied-piping by non-phrase-initial wh-elements in English as QR and assuming that QR has a special status as an Interface Economy-driven operation.

Finally, the proposed analysis of pied-piping can provide a better explanation for variation, both inter- and intra-language, in pied-piping. First, given that two different steps of movements can be involved in pied-piping and that overt and covert movements are interspersed in the narrow syntax, it is predicted that there can be four different types of pied-piping patterns: (i) an XP can be overtly pied-piped by a wh-phrase which is overtly moved to (or base-generated in) its Spec; (ii) an XP can be overtly pied-piped by a wh-phrase which is covertly moved to its Spec; (iii) an XP can be covertly pied-piped by a wh-phrase which is covertly moved to its Spec; (iv) an XP can be covertly pied-piped by a wh-phrase which is covertly moved to its Spec. Secondly, given that the nature of each step of movement involved in pied-piping can be different in different instances of pied-piping, it is predicted that pied-piping will show different properties even when the same kind of overt or covert movement seems to be involved. As an example, I have shown that pied-piping by non-phrase-initial wh-elements in English will show the marked flavor only when QR is involved. This can also explain why large-scale covert clausal pied-piping is possible in languages like Korean and Japanese. Given that these languages are wh-in-situ languages and thus the wh-feature of C is weak, it is predicted that the covert movement of the wh-phrase in these languages can be a syntactic Wh-movement, not QR, as in English. This means that clausal pied-piping in these languages will behave on a par with that in overt Wh-movement languages like Basque and Imbabura Quechua, not restricted by the clause-boundedness of QR.

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